McGill | Faculty of Education | Internships and Student Affairs

November 5, 2019
Room 211 – 10:28 am

Title of lesson	Factored Form of the Quadratic Function	**Grade level**	Grade 10 (9 Advanced)
Subject	Mathematics (Science Option)	**Topic**	Quadratic Functions
Relevance	Quadratic functions can be used to model many situations in our lives (e.g. projectile motion), however there are times when we only know where we start and where we finish with an arbitrary point somewhere along the way. The factored form of the quadratic function allows us to find the rule of the function without necessarily knowing its vertex.		
Resources Required	A projector will be required to show an introductory video and project the first question. Students will also be asked to complete problems on a handout which will be provided to them.		
QEP Subject Area Competencies	**C2 – Uses mathematical reasoning**: The lesson will require students to make use of their previous knowledge of quadratic functions (zeros, solving for parameter a, etc.) to determine the rule of quadratic functions in factored form. **C3 – Communicates by using mathematical language**: Students will be asked to consistently use correct vocabulary when discussing quadratic functions (e.g. vertex, zero, intercepts, parameters, etc.).		
Content focus	**Algebra – Understanding and manipulating algebraic expressions** *B. Analyzing situations using real functions* 1-2, 4-9 → b. Second degree polynomial functions iii. $f(x) = a(b(x-h))^2 + k$, $f(x) = a(x-x_1)(x-x_2)$		
Essential Question(s)	*If we know the zeros of a quadratic function, do we have enough information to find the rule? How might the factored form of the quadratic function be useful?*		

Lesson Timing	**Introduction:**	**Students will know:**
~10 minutes	The class will be shown a video to motivate the lesson before being presented with a related problem. The problem will be projected on the board: As we saw in the video, some celebrate the 5th of November for various reasons (Guy Fawkes Day, for example). To celebrate the day, V launched fireworks in London but one misfired and did not explode. The firework was launched from the ground 50 m from where V was standing and landed on the ground 150 m from him. If we know that the firework was at a height of 90 m when it was at a horizontal distance of 60 m from V, can you find a quadratic function to represent its trajectory? Questions to ask: - What is the rule of a quadratic function? - What do we need in order to find the rule? - What information do we have/don't have? - How else might we be able to solve this problem?	This lesson will teach students another method which can be used to solve problems involving quadratic functions, namely functions in which we know the zeros; they will know when to use factored form. **Students will understand:** Students will develop an understanding of why the factored form uses (and works well with) the zeros of a quadratic function. They will also understand why the sign of a may be different than it should be. **Students will do:** By the end of the lesson, students, using their calculators, will be able to find the rule of a quadratic function in factored form individually and check their answer by considering the sign of a and the shape of the function (open upwards or downwards). **Cross Curricular Competencies:** **1. Uses information** This lesson requires students to identify and interpret information given in the problem such as the zeros of the function, the vertex of the parabola, symmetric points, etc. to find the rule of the function. **3. Exercises critical judgment** As was mentioned above, students will, by the end of the lesson, be able to check their rule based on what they think the sign of a should be. In other words, they will have to think critically about their work. **5. Adopts effective work methods** In mathematics, students are always encouraged to use the most efficient and effective method(s) to solve problems with the least chance of error. **7. Achieves his/her potential** The lesson allots time for students to work individually. This allows the teacher to observe students' work to help them see their strengths and weaknesses, and help them achieve their potential. **9. Communicates appropriately** As was mentioned above, students will be asked to consistently use correct vocabulary (both
~10 minutes	**Development:** Together, the class will work through this example on the board to see how to approach these kinds of problems. Students will provide the ideas and the teacher will question them to reinforce/ensure their understanding and write the ideas on the board; the teacher will facilitate a discussion about how to solve the problem. In the end, the teacher will ask if the final answer can be simplified in any way and explain how it can be (after taking suggestions from the students). This will show students what to look for	

	to see if the sign of a is different than they might expect (i.e. $y = -a(x_1 - x)(x - x_2)$).	mathematical and English) and communicate their knowledge and understanding through their work.
~10 minutes	After doing this example, the teacher will ask students to complete the following example individually. For students who work more quickly and finish before others, they will be asked to list the properties of the function, convert it to standard form and find a relationship between the two forms.	**Broad Areas of Learning:** **1. Career Planning and Entrepreneurship** One aspect of this area is "self-knowledge and awareness of his/her potential and how to fulfill it". While this is not a direct aim of the lesson, students will have the opportunity to see where they can improve and what their strengths are during individual work; this will allow students to become aware of their potential and act accordingly to fulfill that potential.
~5 minutes	Ex. 1) Find the rule of the quadratic function passing through the points A(1, 0), B(4, 6), and C(3, 0).	**Universal Design for Learning/ Differentiation:**
~5-10 minutes	After giving some time to work on the problem, the teacher will go over it with the class before bringing up the question of what happens if the function has only one zero with the following example which will be completed together: Ex. 2) Find the rule, in factored form, of the parabola passing through the point (0, 3) with vertex (1, 0). Questions to ask: - What should we do next? Do you agree? Why? - What happens if we plug a zero into the function as our x-coordinate? - With this information, can we find the rule of the function in standard form? - In what ways might this form be beneficial? How might it be less beneficial than standard form? - Why does a have a different sign? Does this make sense? Does this mean that we are always right about the sign of a? - If a function has only one zero, what might the factored form look like? Why?	- Everything that is written (on the board or elsewhere) will also be said out loud to accommodate for students who are auditory learners. Similarly, everything that is said (that is important) will be written down. - The teacher will suggest different ways of seeing the problem to accommodate for different learning styles and preferences. - The teacher will ask different students to explain the steps taken in solving the problems to provide multiple perspectives on how to go about them. - Visual representations of the problem will be provided for students who are more visual learners.
		FORMATIVE - Assessment FOR learning: After learning how to find the rule of a quadratic function in factored form, students will be given time to work independently on some problems (see **Development**). During this time, the teacher will circulate around the class observing students' work to help them see what they are doing well or where they are going wrong.
		FORMATIVE - Assessment AS learning: While the class works through examples together on the board, the teacher will ask different students to give the next step in solving the problem and/or their understanding of if/why the next step makes sense. The teacher will also ask students to consider if the final answer makes sense or not and why.
	Closure:	**SUMMATIVE - Assessment OF learning:**
~10 minutes	After working on and reviewing the problems students were asked to work on individually, the teacher will give some time to start working on the homework (handout).	A few classes after this lesson, students will be given 3-4 problems about the factored form to complete and submit. Pushing the summative assessment back allows the students to practice the concept more and develop a better understanding of it.

Further considerations (follow up activities)

This lesson incorporates several levels of Bloom's Taxonomy, namely remembering, understanding, applying and analyzing. For students who are quicker than others, creating is also included when students are asked to develop a conjecture about the relationship between the different forms of the function. Additionally, multiple learning preferences are considered with multiple means of representation for various problems. After this topic, students will learn about the general form of quadratic functions to develop an understanding of *why* it is called the factored form.